

इंटरनेट

मानक

### Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 9175-29 (1987): Rationalized Steels for the Automobile and Ancillary Industry, Part 29: Mechanical and Physical Properties of 40Ni10Cr3Mo6 Grade Steel [MTD 16: Alloy Steels and Forgings]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”



BLANK PAGE



*Indian Standard*

**RATIONALIZED STEELS FOR  
THE AUTOMOBILE AND  
ANCILLARY INDUSTRY**

**PART 29 MECHANICAL AND PHYSICAL PROPERTIES OF  
40Ni10Cr3Mo6 GRADE STEEL**

( First Reprint SEPTEMBER 1991 )

UDC 669.14.006.2:629.113

© Copyright 1987

**BUREAU OF INDIAN STANDARDS**  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

*Indian Standard*

# RATIONALIZED STEELS FOR THE AUTOMOBILE AND ANCILLARY INDUSTRY

## PART 29 MECHANICAL AND PHYSICAL PROPERTIES OF 40Ni10Cr3Mo6 GRADE STEEL

Co-ordinating Committee on Materials for Automobiles, SMDC 31

*Chairman*

SHRI C. V. TIKEKAR

*Representing*

Tata Engineering &amp; Locomotive Co Ltd, Pune

*Members*

SHRI A. K. ROY ( *Alternate to*  
Shri C. V. Tikekar )

SHRI V. P. AGRAWAL

Steel Authority of India Ltd ( Rourkela Steel Plant ), Rourkela

SHRI A. K. MALHOTRA ( *Alternate* )

SHRI R. BHANDARI

All India Automobile and Ancillary Industries Association, Bombay

SHRI S. PANIKAR ( *Alternate* )

SHRI R. BHATTACHARYYA

Guest Keen Williams Ltd, Calcutta  
Premier Automobiles Ltd, Bombay

SHRI A. T. BORATE

SHRI J. M. SHAH ( *Alternate* )

SHRI R. R. CONTRACTOR

Automobile Product of India Ltd, Bombay

SHRI V. A. RAJAMONEY ( *Alternate* )

SHRI S. P. DEY

Hindustan Motors Ltd, Calcutta

SHRI V. GOPAL

Lucas-TVS Ltd, Madras

SHRI K. S. SUBRAMANIAN ( *Alternate* )

SHRI S. C. GUPTA

Tata Iron &amp; Steel Co Ltd, Jamshedpur

DR A. N. MITRA ( *Alternate* )

SHRI D. N. GUPTA

Bokaro Steel Plant ( SAIL ), Bokaro

SHRI H. A. JAISINGHANI

Mahindra and Mahindra Ltd, Bombay

SHRI S. RAMACHANDRAN ( *Alternate* )

SHRI R. C. JHA

Steel Authority of India Ltd ( ASP ), Durgapur

SHRI R. C. MODI ( *Alternate* )

SHRI M. L. KATYAL

Bajaj Auto Limited, Pune

SHRI S. R. SALGIA ( *Alternate* )

SHRI S. S. LAKHUNDI

Bharat Forge Co Ltd, Pune

DR M. K. S. CHERUKURU ( *Alternate* )

( Continued on page 2 )

© Copyright 1987

BUREAU OF INDIAN STANDARDS

This publication is protected under the *Indian Copyright Act* ( XIV of 1957 ) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

( Continued from page 1 )

Members	Representing
SHRI S. C. MAHINDRU	Chief Inspectorate of Heavy Vehicles, Avadi
SHRI P. SOMASUNDRAM ( Alternate )	
COL P. M. MENON	Directorate of Standardization ( DGI ), New Delhi
DR V. PANDURANGA	Tractors and Farm Equipment Ltd, Madras
SHRI T. K. SUBBARAYAN ( Alternate )	
DR R. V. PATHY	Mahindra Ugine Steel Co Ltd, Bombay
SHRI R. N. SINGH ( Alternate )	
SHRI K. PARTHASARTHY	Ashok Leyland Ltd, Madras
SHRI T. S. SUDARSHAN ( Alternate )	
DR P. G. PATANKAR	Central Institute of Road Transport, Pune
SHRI L. SHANTARAM ( Alternate )	
SHRI G. R. PRAKASH	Visvesvarya Iron & Steel Ltd, Bhadravati
SHRI B. HARIDASACHAR ( Alternate )	
SHRI R. RAGHAVAN	Enfield India Ltd, Tiruvottiyur
SHRI T. M. BALARAMAN ( Alternate )	
SHRI AJAY KUMAR RAMAN	Escorts Ltd, Faridabad
SHRI S. D. KHANNA ( Alternate )	
DR V. RAMASWAMY	Research & Development Centre for Iron and Steel ( SAIL ), Ranchi
SHRI S. R. MEDIRATTA ( Alternate )	
SHRI C. V. K. MURTHY RAO	Association of Indian Automobile Manufacturers, Bombay
SHRI ANANTHA REDDY	Nagarjuna Steels Ltd, Hyderabad
SHRI J. SRINIVAS ( Alternate )	
REPRESENTATIVE	Ministry of Defence ( DGI )
REPRESENTATIVE	Automotive Research Association of India, Pune
SHRI K. SHANKARANARAYANAN	Directorate General of Technical Development, New Delhi
SHRI S. K. SHARMA	Ministry of Industrial Development
SHRI T. R. SEBGAL ( Alternate )	
SHRI A. R. SONALKAR	Mahindra and Mahindra Ltd, Bombay
SHRI A. R. JANIKA ( Alternate )	
SHRI L. SRINIVASAMADHAVAN	Standard Motor Products of India Ltd, Madras
SHRI K. RANGANATHAN ( Alternate )	
SHRI S. TIWARI	Directorate General of Ordnance Factories, Calcutta
SHRI G. N. ROY ( Alternate )	
SHRI K. RAGHAVENDRAN, Director ( Struc & Met )	Director General, BIS ( Ex-officio Member )

Secretary

SHRI B. K. MUKHOPADHAYAY  
Deputy Director ( Metals ), BIS

( Continued on page 10 )

# *Indian Standard*

## **RATIONALIZED STEELS FOR THE AUTOMOBILE AND ANCILLARY INDUSTRY**

### **PART 29 MECHANICAL AND PHYSICAL PROPERTIES OF 40Ni10Cr3Mo6 GRADE STEEL**

#### **0. FOREWORD**

**0.1** This Indian Standard ( Part 29 ) was adopted by the Indian Standards Institution on 13 March 1987, after the draft finalized by the Coordinating Committee on Materials for Automobiles had been approved by the Structural and Metals Division Council.

**0.2** Part 1 of this standard, published in 1979, covers the chemical composition of 33 rationalized steels. The mechanical properties, hardenability and isothermal transformation characteristics of these 33 rationalized steels are being covered in different parts of this standard ( Parts 2 to 34 ). The data concerning these properties given in this standard is only for guidance and information purposes.

**0.3** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

#### **1. SCOPE**

**1.1** This standard ( Part 29 ) covers the chemical composition, mechanical properties and hardenability and isothermal transformation characteristics of 40Ni10Cr3Mo6 grade of steel for use by automobile and ancillary industry.

---

\*Rules for rounding off numerical values ( revised ).

## 2. CHEMICAL COMPOSITION

2.1 The chemical composition of this grade of steel shall be as given below:

### Constituents, Percent

C	Si	Mn	Ni	Cr	Mo	S	P
0.36 to 0.44	0.15 to 0.35	0.40 to 0.70	2.25 to 2.75	0.50 to 0.80	0.40 to 0.70	0.035 <i>Max</i>	0.035 <i>Max</i>

## 3. HARDNESS

3.1 The maximum hardness for this grade of steel delivered in the annealed condition when determined in accordance with IS : 1500-1983\* shall be 277 HB.

## 4. MECHANICAL PROPERTIES

4.1 The mechanical properties of this grade of steel in the hardened and tempered condition, when determined in accordance with IS : 1598-1977† and IS : 1608-1972‡, shall be as given in Table 1.

**TABLE 1 MECHANICAL PROPERTIES IN THE HARDNESS AND TEMPERED CONDITION**

LIMITING RULING SECTION	TENSILE STRENGTH	0.2 PERCENT PROOF STRESS <i>Min</i>	ELONGATION G.L. 5.65 $\sqrt{A}$ <i>Min</i>	IZOD IMPACT VALUE, <i>Min</i> JOULES AT ROOM TEMP	HARDNESS  HB
mm	MPa	MPa	PERCENT		
150	1 000-1 150	800	12	40	285-341
150	1 100-1 250	880	11	35	311-363
150	1 200-1 350	1 000	10	30	341-401
100	1 150	1 300	7	12	444 <i>Min</i>

## 5. HOT WORKING AND HEAT TREATMENT TEMPERATURES

5.1 The recommended hot working and heat treatment temperatures shall be as given below:

Forging/rolling	1 200°C
Annealing temperature	830-850°C
Process annealing temperature	650-700°C
Hardening temperature	830-850°C
Tempering temperature	660°C <i>Max</i>

## 6. HARDENABILITY

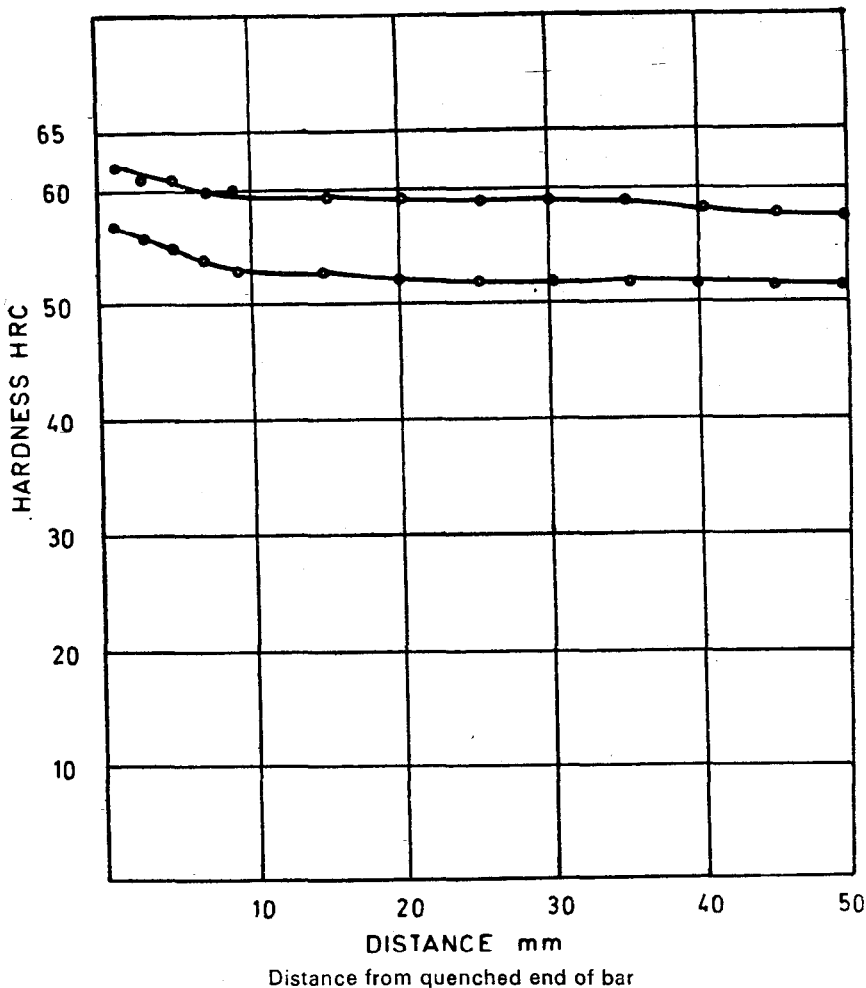
6.1 The end quench hardenability band is given in Fig. 1.

\*Method for Brinell hardness test for metallic materials ( *second revision* ).

†Method for izod impact test of metals ( *first revision* ).

‡Method for tensile testing of steel products ( *first revision* ).



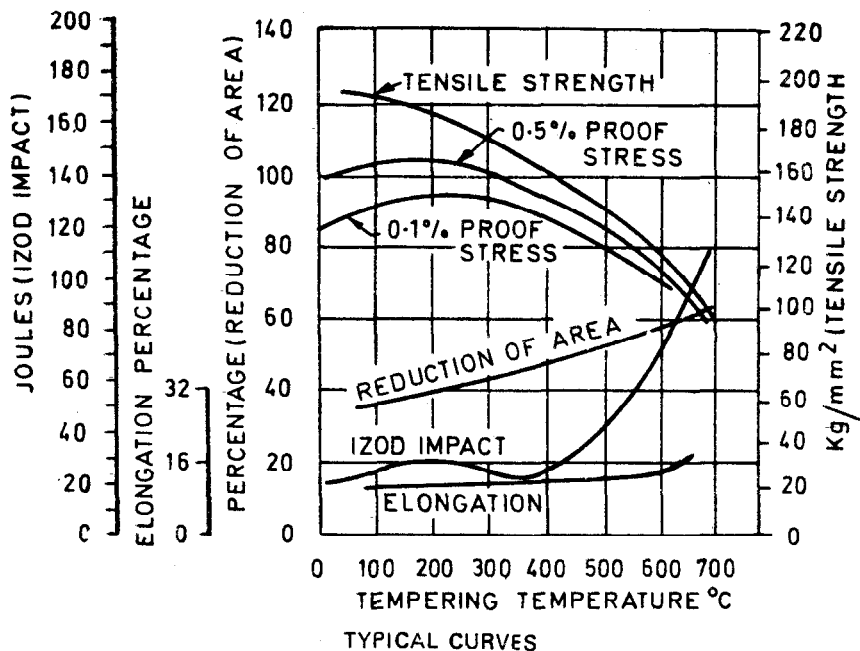


Distance mm	1	2	3	4	5	6	7	8	9	10	15	20	25	30	35	40	45	50
HRC Max	62	62	61	61	61	61	60	60	60	60	60	59	59	59	59	58	58	58
HRC Min	57	57	56	56	55	54	54	54	53	53	53	52	52	52	52	52	52	52

FIG. 1 END QUENCHED HARDENABILITY BAND FOR 40Ni10Cr3Mo6  
GRADE STEEL

## 7. EFFECT OF TEMPERING ON MECHANICAL PROPERTIES

- 7.1 The curves for effect of tempering on the mechanical properties of the steel are given in Fig. 2.



28 mm dia bars oil quenched from 830/850°C

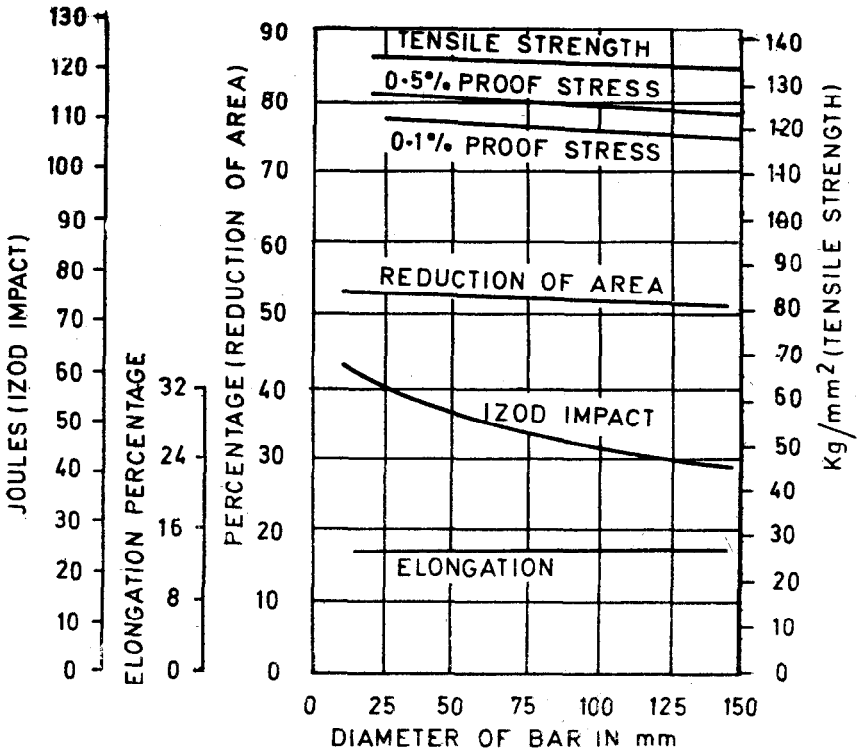
FIG. 2 CURVES SHOWING THE EFFECT OF TEMPERING TEMPERATURE ON MECHANICAL PROPERTIES OF 40Ni10Cr3Mo6 GRADE STEEL

## 8. EFFECT OF SECTION SIZE ON MECHANICAL PROPERTIES

- 8.1 The curves for the effect of section size on mechanical properties are given in Fig. 3 to 5.

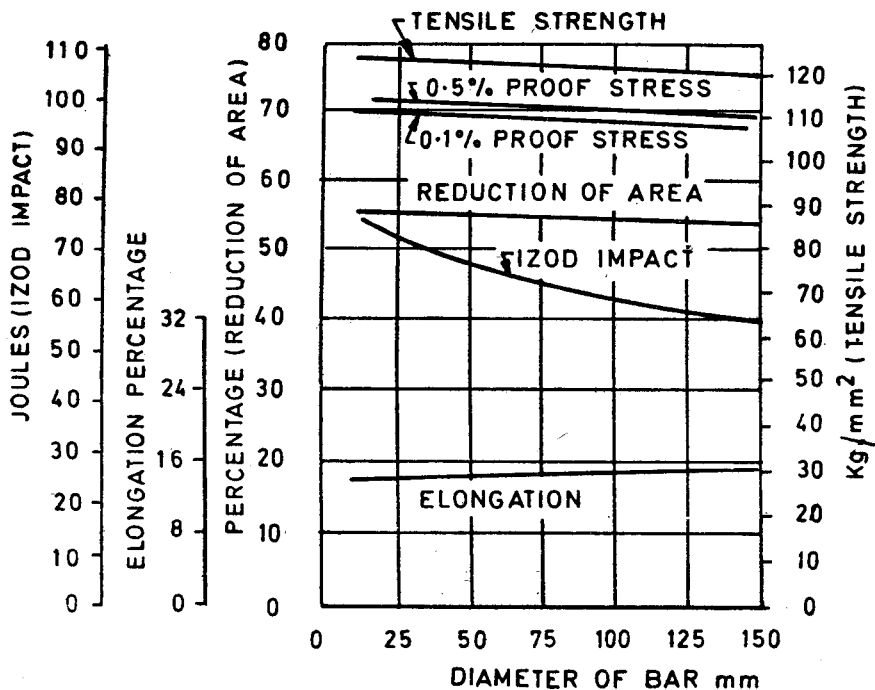
## 9. MACHINABILITY

- 9.1 The machinability of this grade of steel in the annealed condition is approximately 50 percent of that for mild steel (20C8), and in hardened and tempered condition it is 20-35 percent of that for mild steel (20C8).



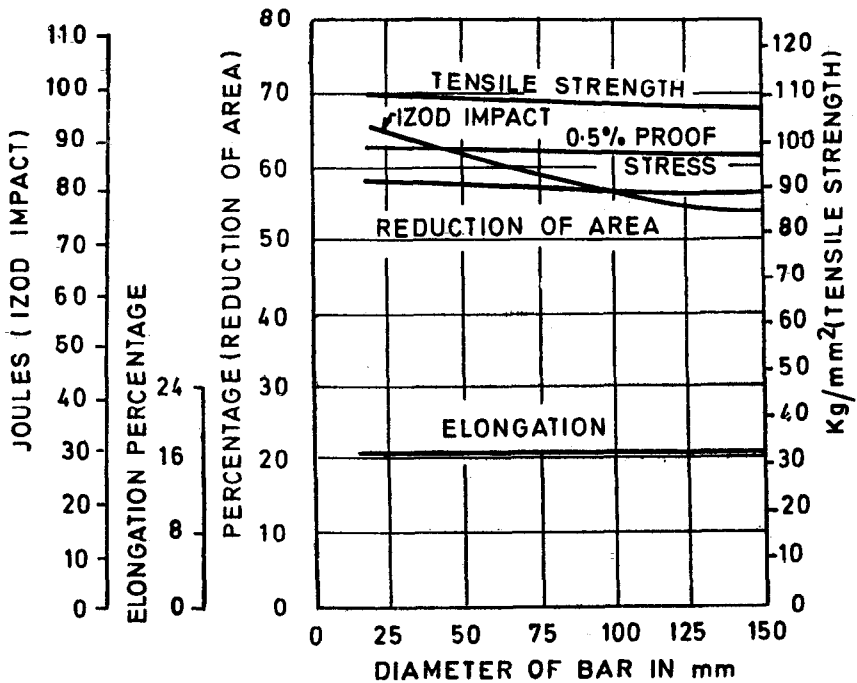
Oil quenched 830°C. Tempered 550°C

FIG. 3 CURVES SHOWING THE EFFECT OF SECTION SIZE ON MECHANICAL PROPERTIES OF 40Ni10Cr3Mo6 GRADE STEEL



Oil quenched 830°C. Tempered 600°C

FIG. 4 CURVES SHOWING THE EFFECT OF SECTION SIZE ON MECHANICAL PROPERTIES OF 40Ni10Cr3Mo6 GRADE STEEL



TYPICAL CURVES

Oil quenched 830°C. Tempered 650°C

FIG. 5 CURVES SHOWING THE EFFECT OF SECTION SIZE ON MECHANICAL PROPERTIES OF 40Ni10Cr3Mo6 GRADE STEEL

( Continued from page 2 )

**Panel to Collect Data on Steel for Automobile Purposes, SMDC 31 : P-12**

*Convener*

**DR R. V. PATHY**

*Representing*

**Mahindra Ugine Steel Co Ltd, Khepoli**

*Members*

**SHRI R. NARAYANAN ( Alternate to**

**Dr R. V. Pathy )**

**PROF R. C. CHATURVEDI**

**Indian Institute of Technology, Bombay**

**SHRI B. HARIDASACHAR**

**Visvesvaraya Iron and Steel Ltd, Bhadravati**

**SHRI D. P. VERNEKAR ( Alternate )**

**SHRI H. A. JAISINGHANI**

**Mahindra and Mahindra Ltd, Bombay**

**SHRI M. G. LAWATE**

**Tata Engineering & Locomotive Co Ltd, Pune**

**DR V. RAMASWAMY**

**Research and Development Centre for Iron & Steel  
( R & D Centre ), Ranchi**

**SHRI S. R. MEDIRATTA ( Alternate )**

**REPRESENTATIVE**

**Automobile Products of India Ltd, Bombay**

**DR K. R. SATYANARAYANAN**

**College of Engineering, Pune**

**DR R. D. CHAUDHARI ( Alternate )**

# BUREAU OF INDIAN STANDARDS

## Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones: 331 01 31, 331 13 75

Telegrams: Manaksanstha  
(Common to all Offices)

## Regional Offices:

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	{ 331 01 31 331 13 75 36 24 99
*Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola, CALCUTTA 700054	
Northern : SCO 445-446, Sector 35-C, CHANDIGARH 160036	{ 2 18 43 3 16 41 41 24 42
Southern : C. I. T. Campus, MADRAS 600113	{ 41 25 19 41 29 16
†Western : Manakalaya, E9 MIDC, Marol, Andheri ( East ), BOMBAY 400093	6 32 92 95

## Branch Offices:

Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMADABAD 380001	{ 2 63 48 2 63 49
‡Peenya Industrial Area 1st Stage, Bangalore Tumkur Road BANGALORE 560058	{ 38 49 55 38 49 56
Gangotri Complex, 5th Floor, Bhadbhada Road, T. T. Nagar, BHOPAL 462003	6 67 16
Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002	5 36 27
53/5, Ward No. 29, R.G. Barua Road, 5th Byelane, GUWAHATI 781003	3 31 77
5-8-56C L. N. Gupta Marg ( Nampally Station Road ), HYDERABAD 500001	23 10 83
R14 Yudhister Marg, C Scheme, JAIPUR 302005	{ 6 34 71 6 98 32
117/418 B Sarvodaya Nagar, KANPUR 208005	{ 21 68 76 21 82 92
Patliputra Industrial Estate, PATNA 800013	6 23 05
T.C. No. 14/1421, University P.O., Palayam TRIVANDRUM 695035	{ 6 21 04 6 21 17

## Inspection Offices ( With Sale Point ):

Pushpanjali, First Floor, 205-A West High Court Road, Shankar Nagar Square, NAGPUR 440010	2 51 71
Institution of Engineers ( India ) Building, 1332 Shivaji Nagar, PUNE 411005	5 24 35

\*Sales Office in Calcutta is at 5 Chowringhee Approach, P. O. Princep Street, Calcutta 700072

†Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007

‡Sales Office in Bangalore is at Unity Building, Narasimharaja Square, Bangalore 560002

Reprography Unit, BIS, New Delhi India